APPENDIX I

Existing FCC Applications

10.1 Saturn 201 Instrumentation Unit.

An FCC system was used to interconnect one measuring rack with its associated equipment in the successful Saturn 201 instrumentation unit. The Mylar-insulated FCC contained 4 x 40-mil conductors on 75-mil center-to-center spacing. It was terminated in NASA/MSFC direct-contact connectors and in existing round wire connectors.

10.2 Standard Missile.

General Dynamics used FCC harnesses in the ordnance section of the standard missile. Kapton H/FEP Teflon-insulated, shielded and nonshielded cables were terminated through transition devices to Hughes Aircraft miniature center-lock screw connectors. Flat cable was used to reduce to a minimum the diametrical space required for the interconnecting harnesses (Figure I-A).

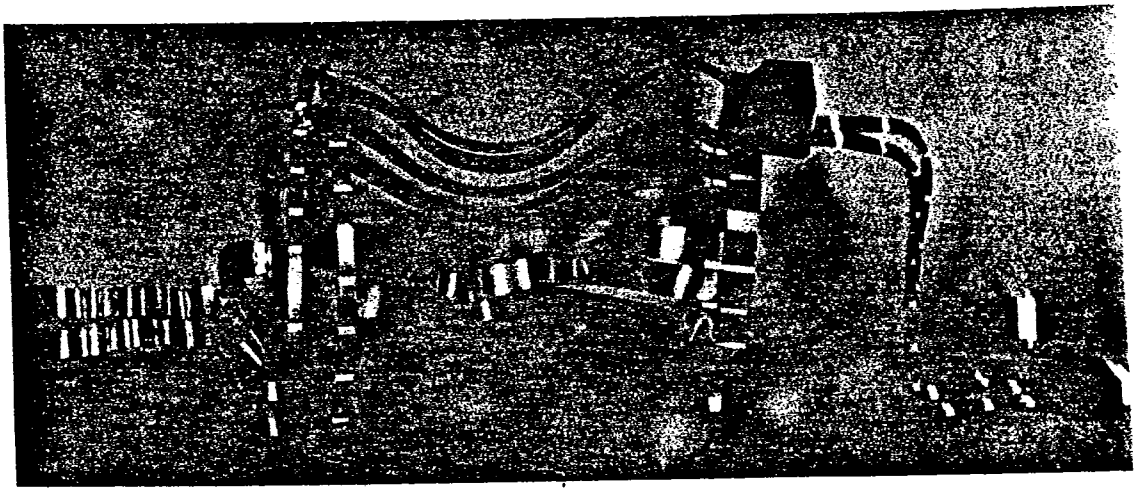

Figure I-A. FCC harness for the standard missile (General Dynamics).

10.3 Apollo Lunar Surface Experiments Package (ALSEP).

In the ALSEP design, Bendix used 50-mil FCC to interconnect lunar experimental packages to a central data package. FCC was selected as the interconnecting cable because of the resulting (1) weight reduction from 10 pounds for conventional wiring to 2.4 pounds for FCC and (2) ease in storing and in extending the lunar packages up to 60 feet from the central data package.

10.4 Hughes Lunar Surveyor Landing Craft.

FCC constructed for specific electrical characteristic requirements was used to interconnect the electronics and the sensor of the alpha-scattering unit used to analyze the lunar soil. This cable contained 4 x 40-mil flat conductors for temperature sensor and heaters, special configuration 3 x 10-mil conductors for alpha and proton gates and 3 x 25-mil conductors for proton sensors. Sprayed-on silver paint was used for the shield, and contact was made directly to grounded connectors through prepunched holes in the insulation (Figure I-B).

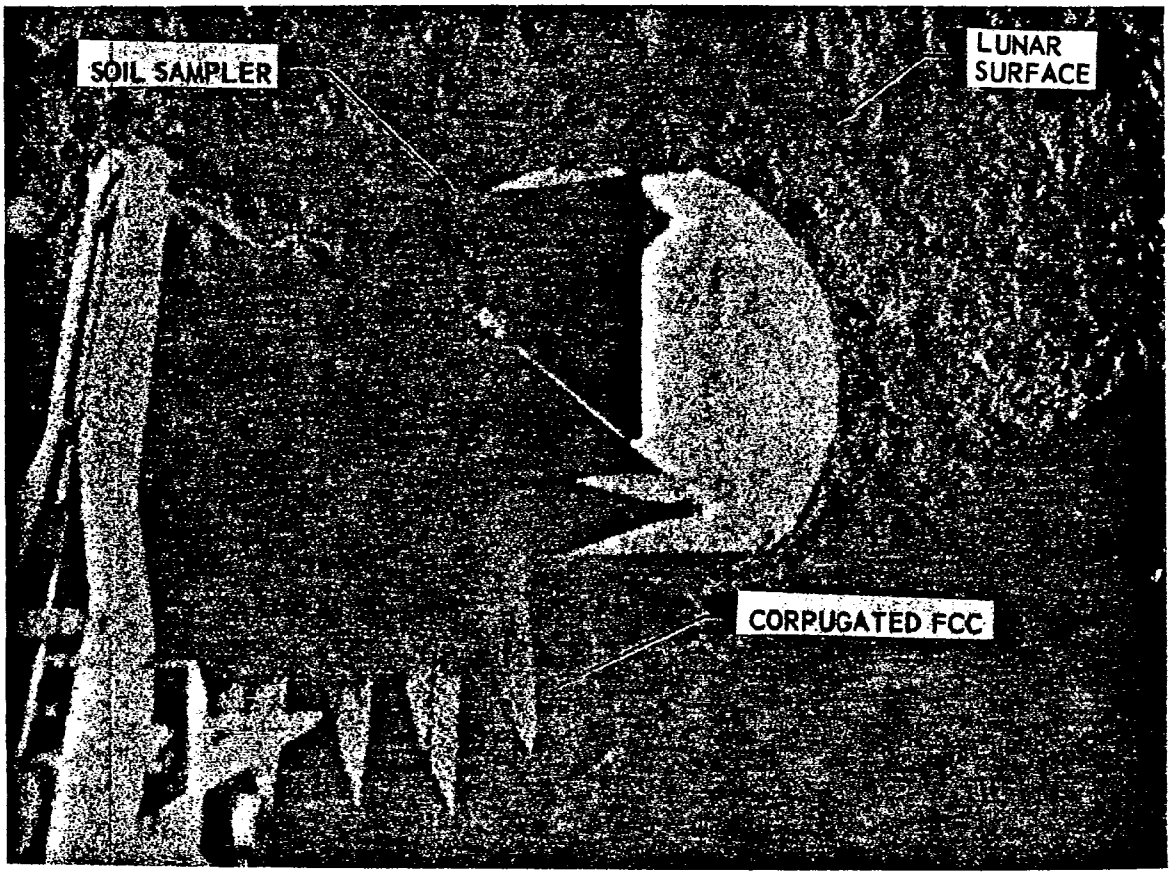

FIGURE I-B. FCC harness on Hughes Lunar Surveyor Spacecraft.

10.5 Lunar Portable Magnetometer (LPM).

In the LPM, FCC is used to connect the sensor head with the electronics and data display assembly. This cable is wound on a spool and can be reeled up when the instrument is not in use. Because the magnetometer assembly was intended to be a portable unit, weight and space considerations were of major importance in the selection of FCC over round wire. FCC used is Kapton insulated, 2-1/2 inches wide and contains 32 conductors (3 x 50 mils). Approximately 50 feet of cable interconnects the assembly parts.

10.6 Electronic Drawer Reels for Saturn-V GSE.

FCC interconnect reels were used to facilitate drawer action on the rack-mounted ground support equipment for the Saturn-V optical tracking system. The reels allowed drawers to be pulled out and tilted 90° up to down while equipment remained in full operation. Two FCC reels were used for each drawer, with 16 cables per reel. Mylar was used for insulating the 1-inch wide cables, and copper shielding was placed between strips where necessary.

10.7 Ships Inertial Navigation Systems (SINS).

Corrugated FCC was used by Autonetics to connect drawers to the console interconnection matrix of an atomic submarine navigation and missile launching complex. Limited space and the need for high reliability under severe operating conditions lead to the decision to use FCC. A corrugated, highly flexible FCC was developed which provided a smooth, rolling action as the drawer was opened or closed. Additional features included copper shielding on both sides, TFE Teflon insulation, and conductor termination by welding through the insulation.

10.8 Naval Shipboard Equipment.

Librascope used 2-inch Mylar-insulated FCC as the total interconnecting medium in a naval shipboard electronics equipment design. Use of FCC enabled drawers to be extended to a service position while equipment continued to operate. The AMP UNTY (trademark of AMP, Inc.) insulation piercing system was used to terminate conductors and shields.

10.9 MK 48 Torpedo Fire Control System.

Librascope used highly flexible corrugated FCC harnesses to connect major unit subassemblies. The shielded Teflon-insulated FCC assemblies, fabricated by Digital Sensors (now part of Ansley West Corp.), provided almost unlimited flex life and a 20 percent saving in space. Use of FCC allowed equipment sections to move both in and out and pivot 90° for service accessibility, while maintaining electrical contact.

10.10 Research Space Vehicle Program.

Digital Sensors (now part of Ansley West Corp.) used FCC in a programmable distributor unit for a research space vehicle program. Round wire cable input-output connectors were interconnected with a wire-wrap plane by continuous FCC. This design permitted programmed, automatic production interwiring and simple hand rework for circuit change to the instrumentation circuits after initial fabrication. Shielding was used between FCC layers. The unit size was 7 x 8 x 5 inches.

10.11 Minuteman II Gyro.

Autonetics used a special FCC gyro cable with very low torque requirements in the Air Force Minuteman II. This cable assembly, manufactured by Digital Sensors (now a part of Ansley West Corp.), provided a rotary electrical connection between gyro and housing. The Teflon insulated multilayered FCC contained 48 conductors with a .050-inch center-to-center spacing. Shielding was used between cable layers. Cable termination was accomplished by welding through the insulation to ITT Cannon MICRO-D connectors.

10.12 Upstage Guidance Command Unit.

Flat conductor jumper cables are used by McDonnell Douglas to interconnect PC cards, multilayer boards and thick film substrates. Two basic types of jumper cables are used. One type uses 3 mils of Mylar plus 3 mils of adhesive on each side of the conductors. These jumpers, procured from Methode, are stripped at the ends and between the ends. Stripped areas are lap soldered to foil type conductors. The other jumpers are Ansley West Flexstrip with one piece conductors which are round in the uninsulated ends and flat between the ends. Teflon insulation is laminated over the flat conductor area. The round pins install through the units to be joined and are soldered in place.

10.13 Spartan Warhead.

McDonnell Douglas uses FCC assemblies on the Spartan vehicle to transmit control and instrumentation signals through the warhead section. The H/FEP flat cable has transitions to round wire cable at both ends to permit the use of existing qualified blind mating connectors. The transitions are made with Thomas and Betts powdered metallurgy molded copper splices.